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ABSTRACT

Through computer simulation activities, building designs can be tested and evaluated before construction begins, alternatives developed, and cost-benefit ratios analyzed. Annotations of 15 publications in the ERIC system that involve the use of computers and school planning are contained in this digest. (Author/MLF)

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COMPUTERIZED PLANNING METHODS 3

EDUCATIONAL FACILITIES DIGEST

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COMPUTERIZED PLANNING METHODS

by Philip Piele and Darrell Wright

Planning modern educational facilities and instructional programs has become a complex task. Shifting student populations, inflating costs, and public reluctance to approve expenditure of funds create problems that require more accurate and efficient planning than was necessary in the past.

Modern technology can be used to replace old techniques and to solve modern problems. The electronic wizardry of data information systems processed by computers provides one modern technological tool for facilities planners and architects.

The use of computer planning methods offers advantages human planning methods cannot achieve. Modern technology can be employed to remove the risk of failure. Through computer simulation activities, building designs can be tested and evaluated before construction begins. Modifications and revisions can be made, and the design can be evaluated once more. In a matter of hours, simulated buildings can be built, demolished, and rebuilt with no risk to human safety or expenditure of capital funds.

Computerized planning methods perform varied and complex tasks that would tax the human mind beyond endurance. To cite specific examples, one computer model can analyze an instructional program to determine the amount of floor space necessary. By inputting instructional program information, planned student enrollment, and a proposed floor plan, the computer program is used to analyze the adequacy of the floor plan, enabling modifications before actual construction begins.

Another computer program can use data showing the number of students enrolled in the various departments and educational specifications to develop an estimate of the traffic flow between departments. This simulation activity depicting potential traffic flow contributes to the planning

of floor plans that minimize student traffic.

Two computerized linear systems, PERT (Program Evaluation Review Technique) and CPM (Critical Path Method), are used to manage facilities construction events. The original PERT method estimates the duration of a project at three time levels (optimistic, pessimistic, and most likely), while CPM determines only one time estimate schedule for the project. Both programs reveal the complex interrelationships of simultaneous events to increase planning effectiveness and construction efficiency.

A third program, developed in Czechoslovakia, schedules statewide building construction programs according to priority, resource capacity, time coordination, and construction schedules.

Facilities planners can ask computer simulations to create floor plans, evaluate heating, ventilating, and air conditioning (HVAC) systems, detect deficiencies in design, choose school sites, and develop construction schedules. When facilities are being planned, the computer can make changes occur over time, encourage the development of alternatives, and analyze cost-benefit ratios to provide more accurate and complete information.

But, computer planning methods are just tools in the vast field of facilities planning, design, and the environment. Taken alone, the computer program is a fascinating instrument of science that can assist humans with their complex problems. Taken in the context of people's needs and the environment, computer planning methods are for the human mind to use in maintaining this planet in its beauty and natural harmony.

"Architect's Aide: A Computer." *American School and University*, 44, 3 (November 1971), pp. 43-46. EJ 047 240.

Using the design formula called computerized relative allocations of facilities technique (CRAFT), architects were aided in developing a facilities floor plan. Departmental student enrollment information and educational specifications provide input for the computer to calculate the number of student exchanges and related distances between the departments preliminary to developing an estimation of traffic flow between departments. Then, by including space scale, departmental space areas, and some architectural considerations, a computerized layout can be developed.

Costs were subjectively arranged by trial and error into a "nuisance array."

Preprinted computer-assisted layouts are said to save time and furnish the architect with valuable planning information. Explanatory tables are included.

Bazjanac, Vladimir. "Computer Simulation: A Realistic Assessment." *Progressive Architecture*, 52, 7 (July 1971), pp. 80-82. EJ 045 502.

The greatest value of dynamic computer simulation models, grouped according to function (accounting, functional performance, visual simulation, and residual models), seems to be in what the user learns. The architect or planner can use computer simulation models to learn more about the problem, develop a better understanding of how the actual system works, and detect deficiencies and inconsistencies in the design. Simulations may encourage the consideration of more alternatives since the risk of failure is removed.

Because every simulation model is developed on a set of assumptions containing a series of simplifying conditions, the prediction value is limited and questioned. However, the simulation model can be a valuable aid to thought by making changes occur over time.

Bregar, William S. *Improvement of Elementary School Designs through Simulation of Educational Activities. Final Report.* Madison, Wisconsin: University of Wisconsin, 1973. 68 pages. ED 075 942.

With the intention of providing a link between educators and architects, a computer simulation program was developed to test proposed school designs. Developed to accept information about school program designation, planned enrollment, and a proposed floor plan, the computer program analyzes the space adequacy of the proposed floor plan for the planned activities.

This report describes a systematic procedure for determining the elements of instructional and activity programs that influence or are influenced by the limitations of space in a school building. Data collection procedures, data analysis, and the details of simulation technique are included with sample forms appended.

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Cole, Tony. "Approaches to Computer Use in Planning Buildings." *Build International*, 5, 6 (November-December 1972), pp. 372-382. EJ 069 189.

The Lund Institute of Technology, Sweden, has developed computer methods for planning buildings in an attempt to increase the capabilities of existing computer methods, to increase the number of variables handled, and to bring the computer nearer to the designer for easier use.

This article develops the Whitehead and Eldars algorithm for problems on multiple floors; it also develops an algorithm for the definition of circulation routes in computer-developed plan arrangements. These programs are part of the DESIGN system, which attempts to create a system allowing interactive design of buildings. The DESIGN system may become a central core to which other computer methods can be added.

In order for computer methods to be useful and relevant, they must (1) reflect the fact that the building design problem is multivariable and that the importance attached to each variable is not fixed but subject to social discussion, (2) be easily accessible to the user without long delay

between input and receipt of results, and (3) present results in a simple manner. The author concludes that interactivity will satisfy these three requirements.

Fredrickson, John H. "The New Planning and Building Terms." *School Management*, 18, 1 (January 1974), pp. 52-54. EJ 089 408.

Project Evaluation Review Technique (PERT) and Critical Path Method (CPM) are described as computerized linear systems used to manage facilities construction projects. The programs are similar in that they utilize computer technology to graphically display the complex interrelationship of construction events. Fredrickson suggests that construction management problems can be anticipated more effectively by using either PERT or CPM computer programs.

Friedmann, John. "In Step with Tomorrow." *AIA Journal*, 56, 1 (July 1971), pp. 19-26. EJ 040 754.

Embracing the problem of potential changes in goals and needs for facilities, the CLUSTER computer program was used to develop a facilities construction plan for mental health services. It is said to be applicable to any type of facility.

Essentially, the computer program breaks the planning problem into a series of functional requirements and recombines them into interactive subsets called simplexes. A facility design is accomplished by applying a specifically developed diagram language to express the functional requirements of the computer-combined subsets. Accompanying diagrams illustrate the process and the computer's organization of the problem. This program is used to plan facilities where goal changes may create a difference between short- and long-range needs.

Hall, Fred L. "A Preliminary Evaluation of an Optimizing Technique for Use in Selecting New School Locations." In *Educational Facilities Planning in Chicago: Selected Case Studies*, edited by Ashraf S. Manji, pp. 51-79. Chicago: Chicago Board of Education, 1974. Entire document, 195 pages. ED 095 633.

An optimizing method that features an integer programming technique was used by Hall in selecting new school locations in Chicago. This report describes the mathematical formulation of the integer program, presents a case study of its application, and evaluates the findings of the case study.

Hall suggests that the integer program is useful in determining the optimum location of schools and the optimum allocation of attendance areas. He points to its potential as a planning tool for facilities planners.

Order copies from Center for Urban Educational Planning, Chicago Public Schools, 28 East Huron Street, Chicago, Illinois 60611. Free.
Entire document also available from EDRS. MF $0.76 HC $9.51. Specify ED number.

Hunt, Lester W., and Burr, Donald F. *Research, Development and Dissemination in Educational Planning and Educational Facilities Planning. Project Simu-School.* San Jose, California: Santa Clara County Office of Education, 1974. 45 pages. ED 089 465.

Sodt Elementary School, Monroe, Michigan. Warren Holmes & Kenneth Black Assoc. Architects. Photo by Greg Hursley.

Project Simu-School is part of the National Center for Educational Planning. Hunt and Burr report on the project's nationwide network of developmental components for research, development, and implementation of new planning processes. Specific objectives are listed as (1) developing and implementing effective educational planning using computer simulation, gaming, and mathematical modeling; (2) training educational planners to solve problems in a variety of environments; (3) testing alternative solutions to planning problems; and (4) forecasting the kinds of future problems that may arise.

Part 1 is a position paper that describes the functions, roles, and relationships of the various national components of Project Simu-School.

Part 2 contains excerpts of a position paper concerning Project Simu-School services and operations, with a concluding statement of the project's significance.

The planned National Center for Educational Planning intends to create a computerized Planning Information System to function as a data base for educational planning research.

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McClure, Charles J. R. "Computer Review Can Cut HVAC Energy Use." *Nation's Schools*, 93, 6 (June 1974), pp. 57-59. EJ 097 881.

McClure recommends that schools hire a consulting engineer not involved in the original design of the school to do a computerized review of construction bidding documents. The result would be the gathering of information that would show how to save on energy.

The computer can generate a variety of energy consumption figures from a review of the computerized load calculation, the energy systems flow diagram, the control system analysis, and the computerized building energy consumption calculation.

The figures and alternatives from an actual computer analysis of a planned HVAC system are presented to support and explain the predicted benefits.

McGuffey, Carroll W. *Systematic Planning for Educational Facilities.* Chicago: Department of Facilities Planning, Chicago Board of Education, 1973. 128 pages. ED 090 674.

The conceptual and practical problems of the systematic planning of educational facilities are presented in a conceptual framework for a general facilities planning and management system called Facilities Resource Allocation Management Evaluation System (FRAMES). The FRAMES model assumes that a single facility is a subsystem of a total system, the school district. The main components are needs assessment, facilities programming, resources allocation and distribution, facilities management, and evaluation.

This monograph focuses on the needs assessment component, which is defined as a process for determining the discrepancies that exist between existing facilities and what is needed. The program is a five-part model called GONA, whose major components are community aspects, pupil population, educational program, existing facilities, and fiscal aspects.

The author hopes that facilities planning will move in the direction of considering the impact of future events on the development of educational facilities.

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Moucka, Jan, and Piskova, Vera. "Computerized Construction Planning." *Build International*, 4, 5 (September-October 1971), pp. 293-296. EJ 045 855.

Two Czechoslovakian architects have developed a computer program to schedule statewide building construction program components such as project priority, resource capacity, time coordination, and construction schedules.

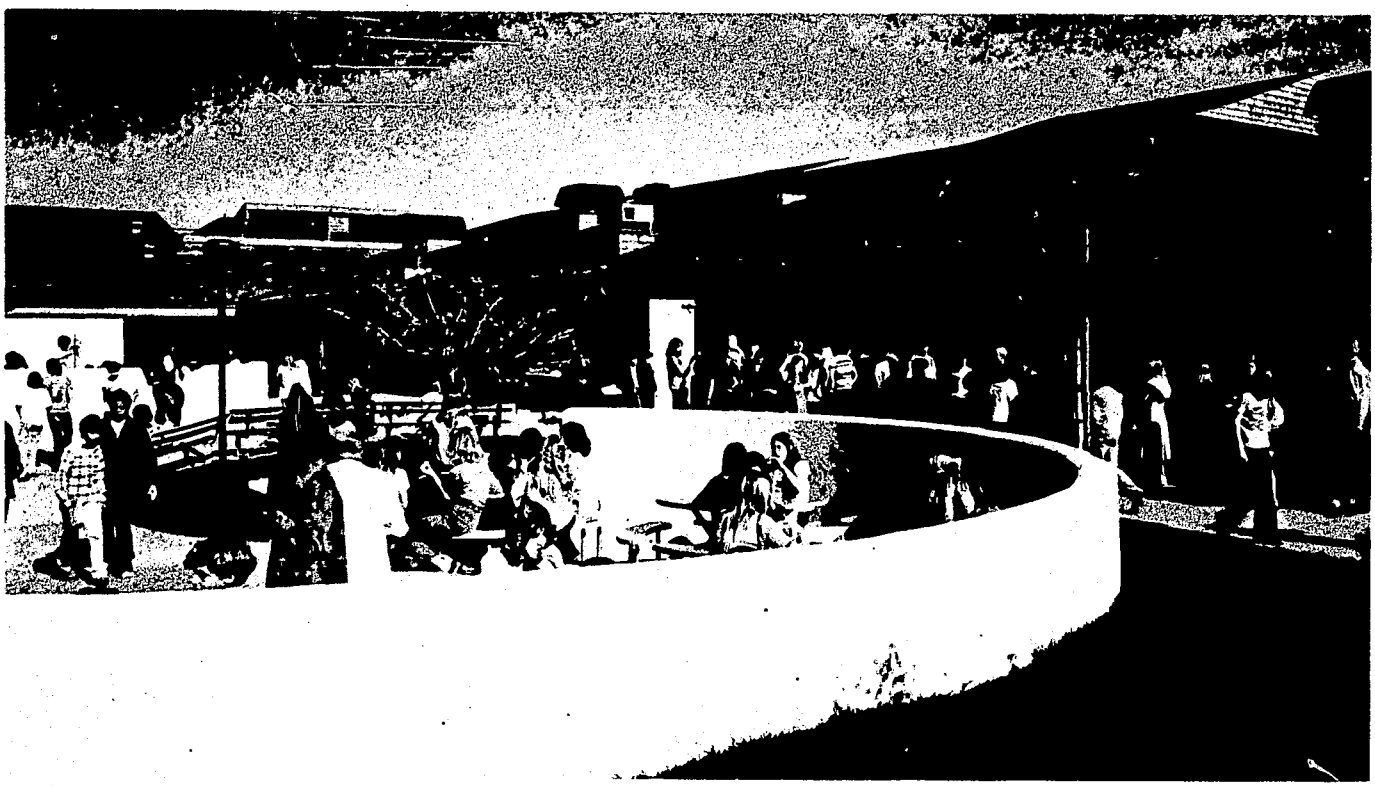
Two specific problems are addressed: (1) to schedule individual projects so that their finish dates are met, allowing for both the time relationships between the individual projects and their dependence on external supplies; and (2) to schedule the individual projects so that the demand for resources never exceeds their supply.

A resource allocation and planning method called RPZM was developed for a small computer to solve problems in which every activity imposes uniformly distributed requirements on resources for its whole duration.

Explanatory diagrams accompany the text.

Mitchell, William J., editor. *Environmental Design: Research and Practice.* Volumes One and Two. (Papers presented at joint proceedings of Environmental Design Research Association and AIA-Architect-Researchers annual conference, Los Angeles, January 1972.) Washington, D.C.: American Institute of Architects, 1972. 1,297 pages. ED 079 828.

Computer planning models are tools in the vast field of design and the environment. Planners use computer models but not in an isolated environment separate from people and their needs. This collection of 150 papers provides the total perspective that surrounds the use of computer programs for facility planning.



Venado Middle School, Irving (Calif) Unif. School District. Photo by Janet Isbell of William Blurock & Partners, Architects

Man and environmental relations, personal space, behavior in complex environments, methods for investigating imagery and meaning, environmental quality, comprehensive design strategies, simulation, and games are among the categories of topics treated by authors in this collection.

Several papers deal directly with computer planning models and methods. Storing and retrieving design data are discussed by Mark D. Estes in "Data Management Techniques Applied to People/Activity Relationships within the Built Environment." R. Dunning Roberts presents Compucon, a system for comparing alternative facility design configurations. Lavette C. Teague, Jr. and Charles F. Davis III compare RAMIS and TABLE, two computer systems used by Skidmore, Owings, and Merrill. Thomas W. Maver in "PACE 1: An On-Line Design Facility" presents an interactive computer program that can be used to modify a design scheme, to compare alternative layout design strategies, and to generate causal relationships between design variables.

Other papers deal with predictive models, man-machine systems such as HUNCH and CEDAR, and computer-assisted design decisions and automated space planning.

Order copies from American Institute of Architects, 1735 New York Avenue NW, Washington, D.C. 20036. $27.50.
Also available from EDRS. MF $2.18 HC $65.39. Specify ED number.

Oswalt, Felix E. *Computer Profile of School Facilities Energy Consumption.* Memphis, Tennessee: Memphis City School System, 1972. 7 pages. ED 078 508.

Oswalt describes a computerized management tool that enables administrators to identify the amount of energy consumed by different types and various uses of facilities. The tool is intended for use in evaluating and planning new facilities. It generates statistics that can be used to evaluate different types of building enclosures in terms of energy consumed, to compare mechanical systems, and to forecast the amount of funds that must be budgeted for energy consumption.

Besides facilitating planning, the statistics will provide information related to human elements of operation. The information will also help administrators to identify malfunctions of equipment and to identify inefficient equipment needing repair or replacement.

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Ritzman, Larry P. "The Efficiency of Computer Algorithms for Plant Layout." *Management Science,* 18, 5 (January 1972), pp. 240-248. EJ 058 347.

This paper presents the results of experimentally comparing four computer algorithms developed to solve plan layout problems. By applying 26 test problems, the CRAFT algorithm, the Hillier-Connors routine, the Wimmert procedure, and a random solution routine by Seehof and others were evaluated with respect to computer time requirements and objective function values.

Ritzman found the CRAFT algorithm to be the most efficient of the four because it seemed to provide good answers regardless of the type of problem. The Hillier-Connors routine was only slightly less efficient.

Shuck, Les E. "Computer Predicts Facility Requirements." *American School and University*, 46, 9 (May 1974), pp. 69-73. EJ 097 873.

The Newport-Mesa (California) Unified School District has developed a five-year enrollment projection and a required facilities plan by using a computer program that analyzes land development, housing types, and other data. The DEC system-10 computer is used for decisions on facilities development, expansion of individual schools, projection of transportation requirements, and reassignment of students and teachers.

This article contains five brief case studies to describe computer applications and suggests that human decisions can and do override computer directions.

This publication was prepared pursuant to a contract with the National Institute of Education, U.S. Department of Health, Education, and Welfare. Contractors undertaking such projects under government sponsorship are encouraged to express freely their judgment in professional and technical matters. Prior to publication, the manuscript was submitted to the Council of Educational Facility Planners, International, for critical review and determination of professional competence. This publication has met such standards. Points of view or opinions, however, do not necessarily represent the official view or opinions of either the Council of Educational Facility Planners, International, or the National Institute of Education.

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